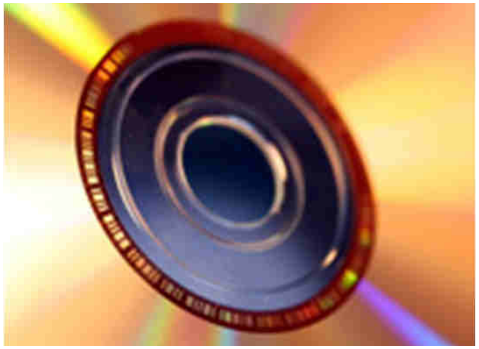

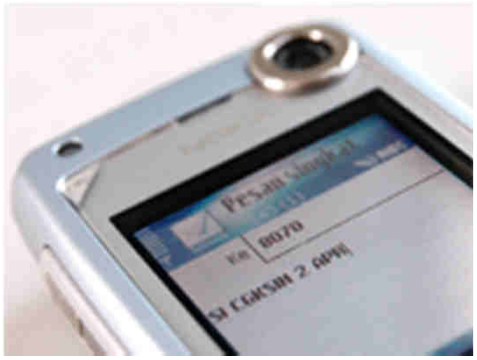

MICROPHONES

PRINCIPLES, CONSTRUCTIONS, CHARACTERISTICS AND APPLICATIONS

Study aid to learn Communication acoustics, VIHIAM 000

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Dept. of Networked Systems and Services
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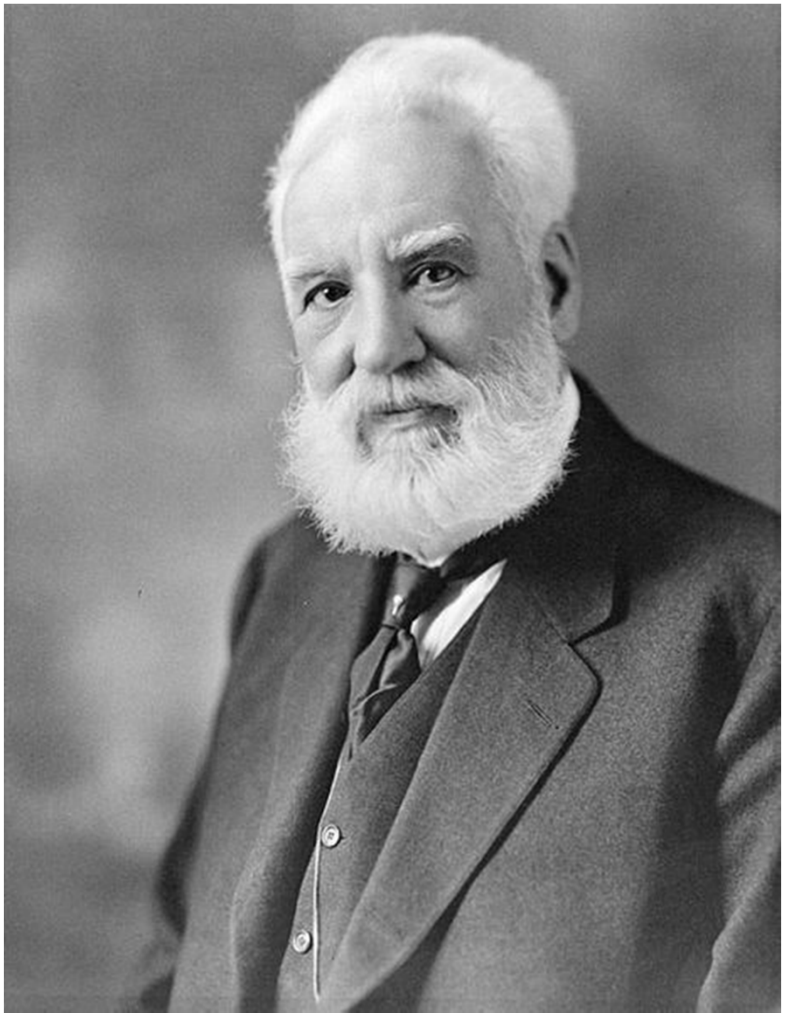
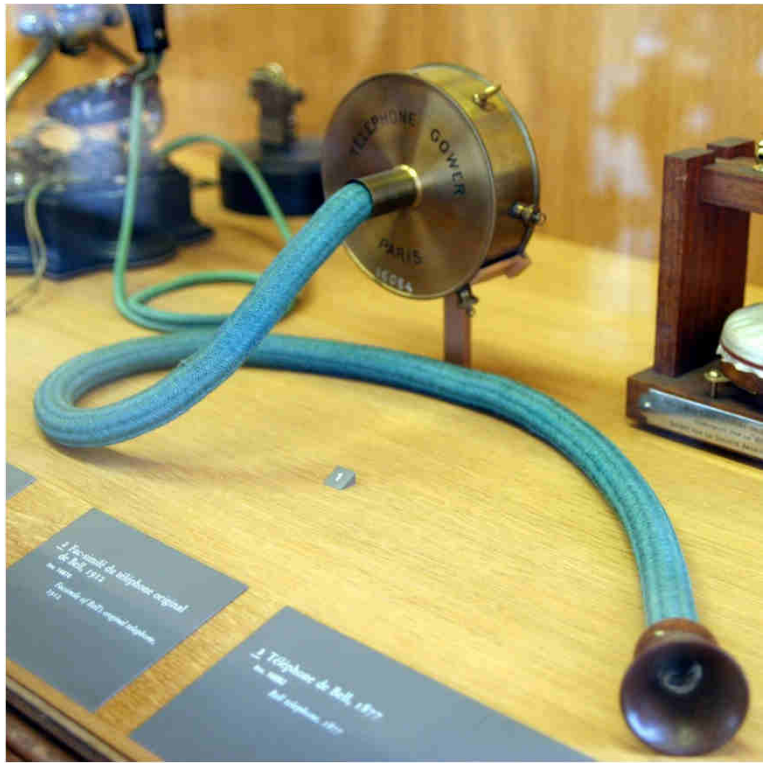
2018. november 20.,
Budapest

The first carbon microphone

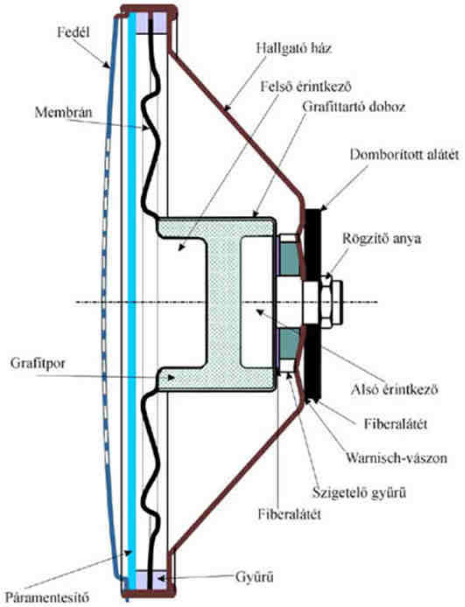
- US Patent: „…an apparatus for transmitting vocal or other sounds telegraphically…„ (1876)





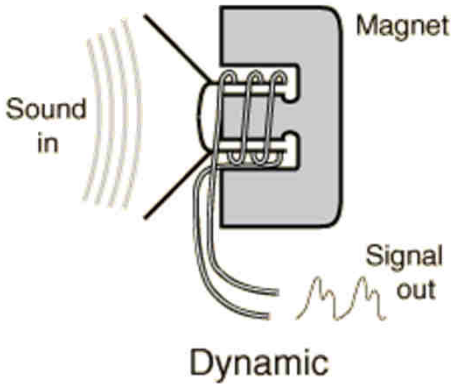
Copy
(Musée des Arts et Métiers, Párizs)

A „modern” carbon microphone

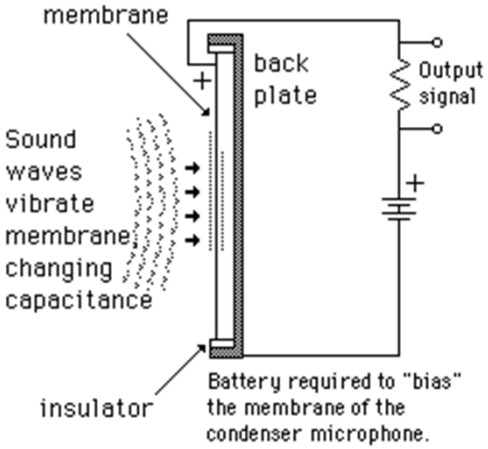


Basic principles

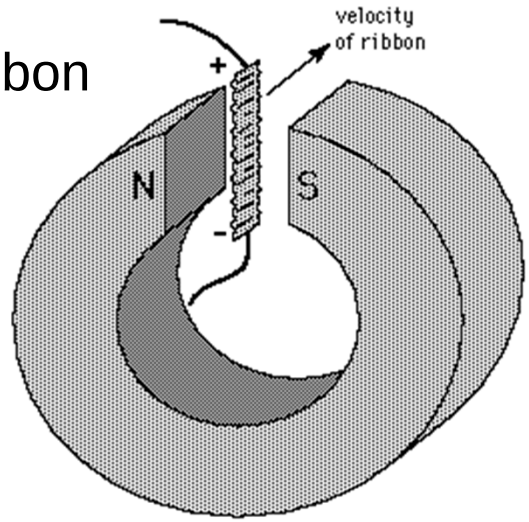
Dynamic



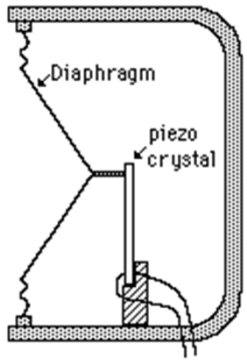
Condenser



Ribbon



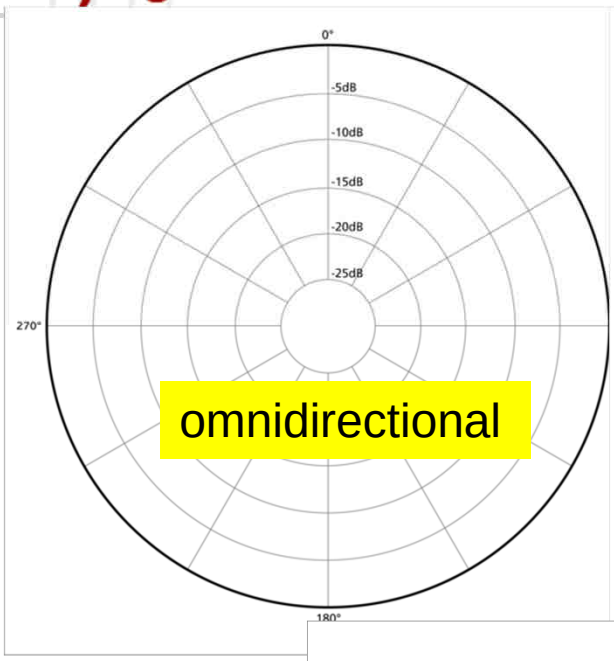
Piezoelectric



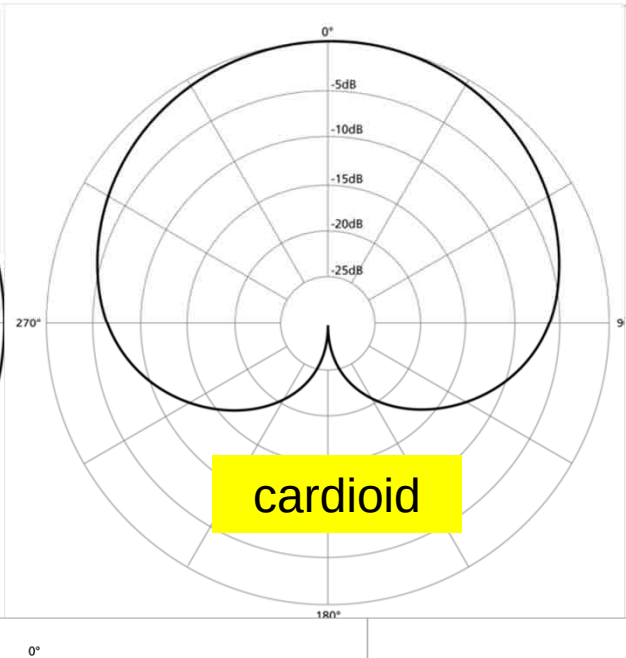
Microphone characteristics

- Sensitivity
  - **mV/Pa,** dBV/dB SPL, stb. mV/20μPa
- Frequency response
  - **sensitivity in dB** vs. frequency
  - always in the main axis of the mic
- Directional sensitivity / polar diagram
  - **sensitivity in dB** vs. direction
  - parameter: frequency
- Distortion
  - total power ratio of harmonic components, in response to pure sinusoidal input, in % (THD, sometimes in dB too)
- Dynamics
  - Range of maximum output voltage without distortion, referred to the background noise level, in dB.

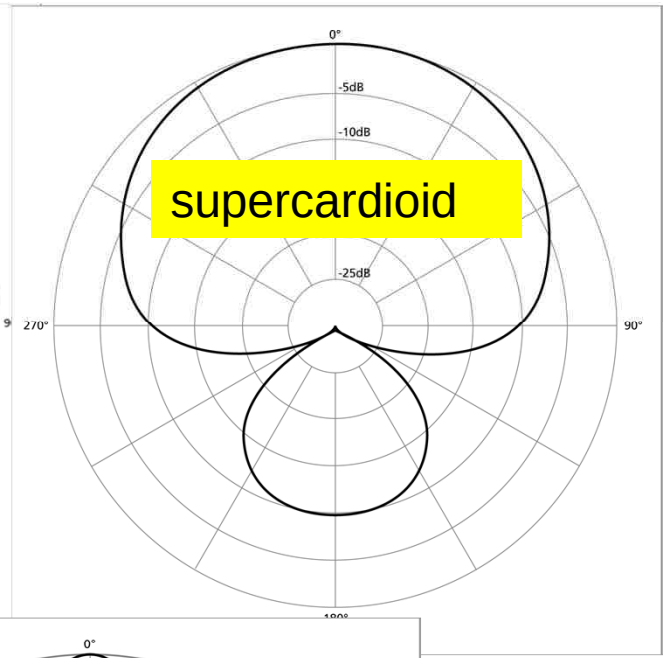
Directivity patterns of microphones



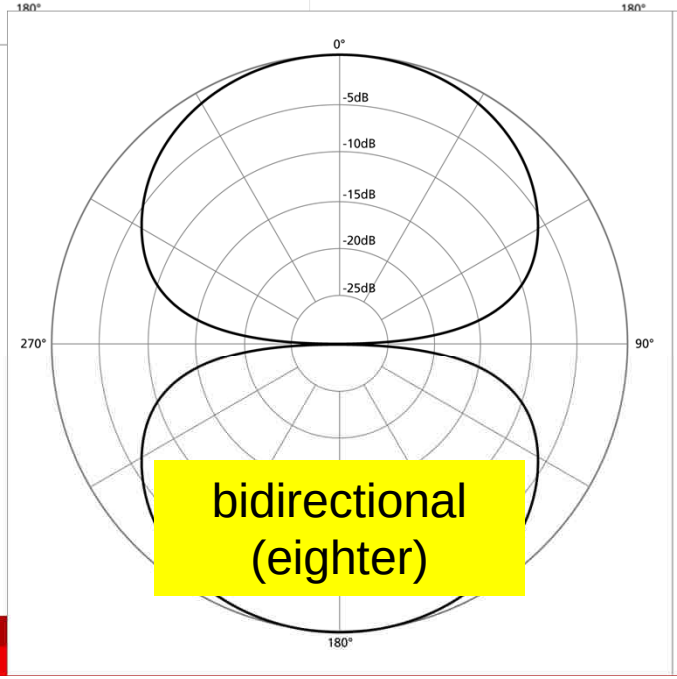
omnidirectional



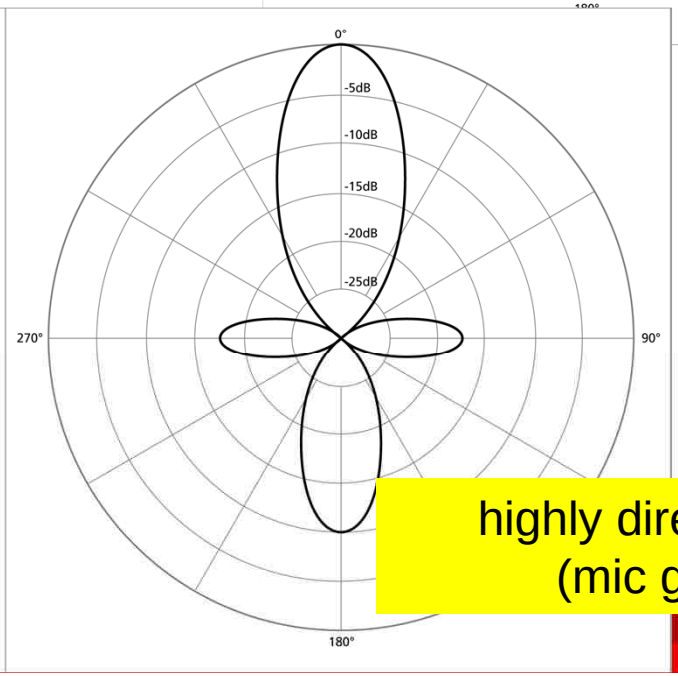
cardioid



supercardioid



bidirectional
(eighter)



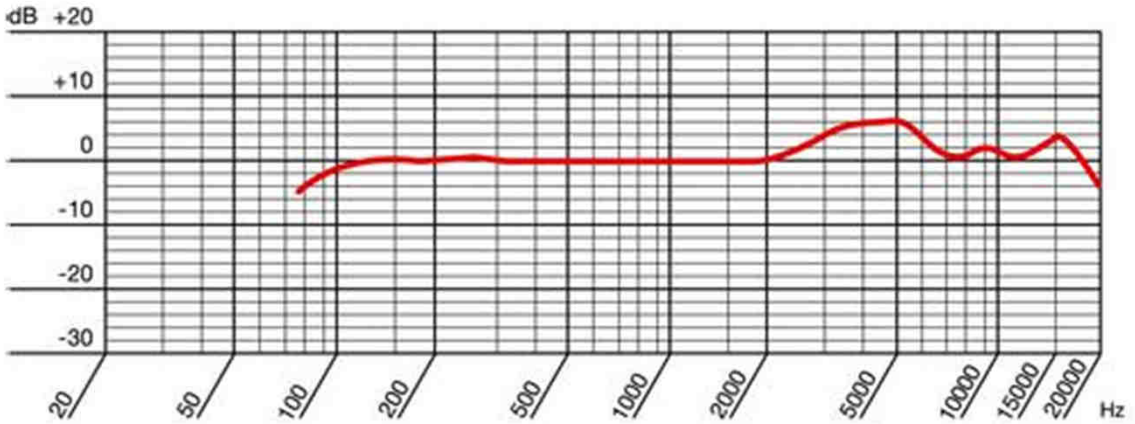
highly directional
(mic gun)

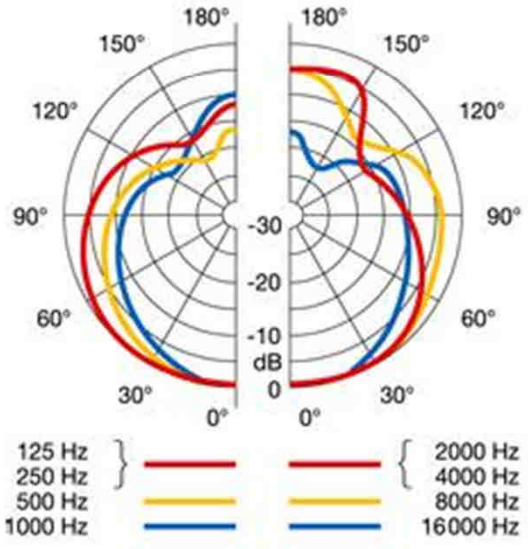
Applications

- on the basis of technical parameters:
  - of highest sensitivity but bad quality: piezo (in portable devices, very robust)
  - of medium sensitivity, very good quality: condenser (measurements, studio applications)
  - of low sensitivity but robust, cheap and with reasonable frequency response: (electro)dynamic (vocal, speech, PA, general purpose)
  - highly directional, good quality but vulnerable : ribbon (instrumental music and vocal, studio applications)

- on the basis of price:
  - piezo in mobile devices
  - condenser and ribbon for studios
  - high quality condenser for measurements

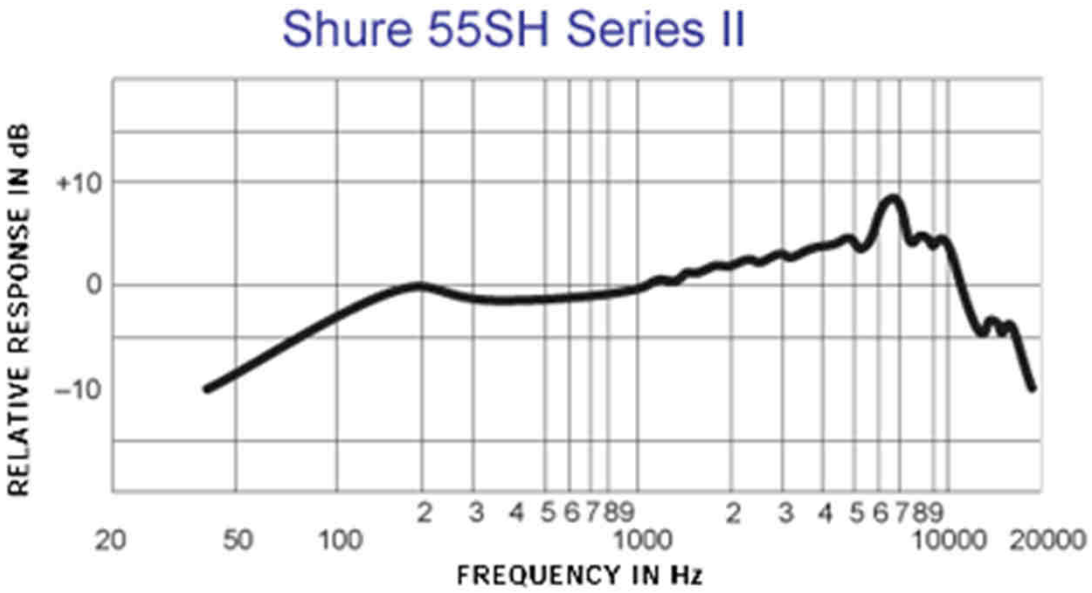
A typical dynamic microphone



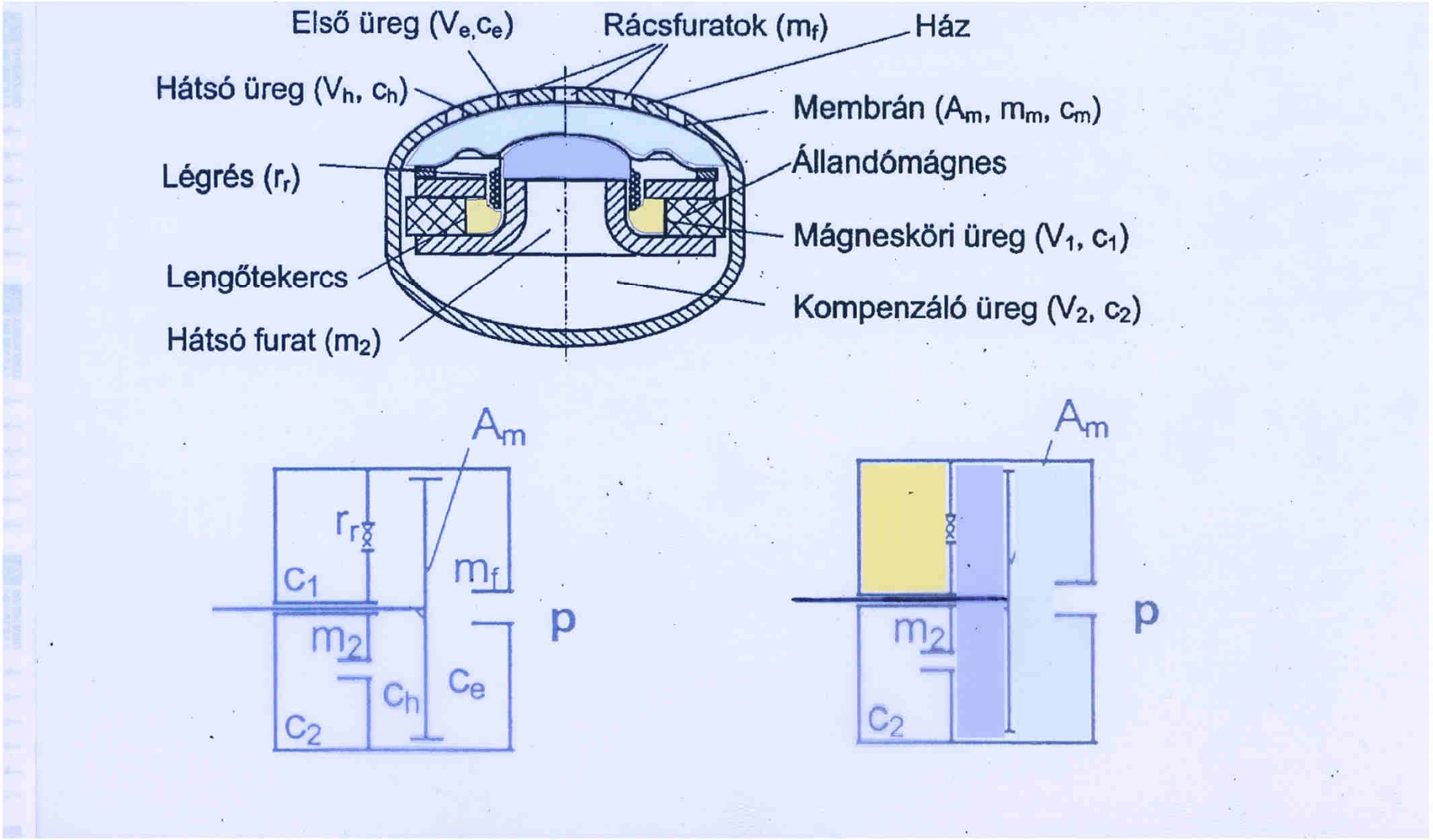


D 50 S

Another, iconic dynamic mic



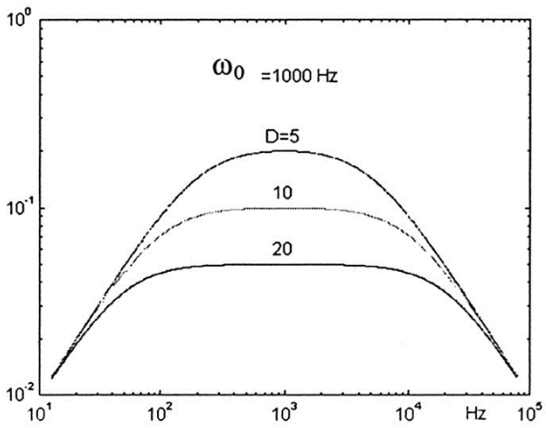
Construction of a dynamic mic

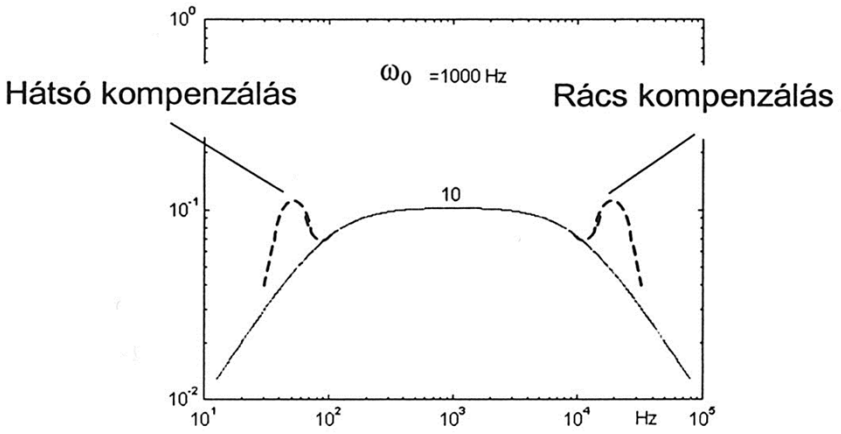


Frequency response of dynamic mics

- The typical dynamic microphone is actually a mass-spring system, having a bad frequency response

  $\Rightarrow$ compensation is required





A condenser microphone

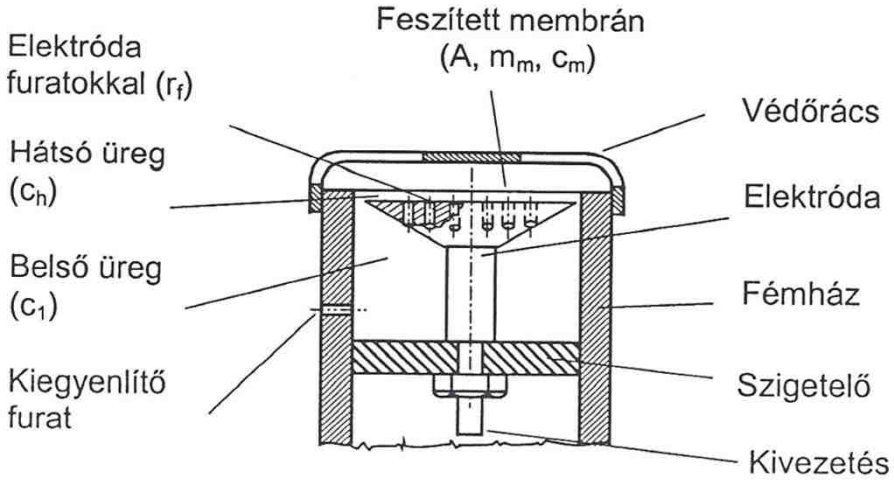
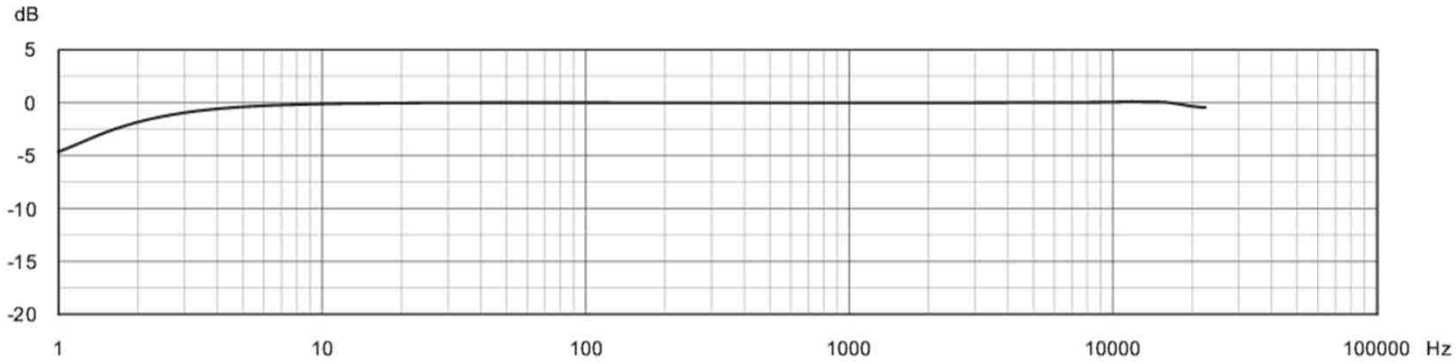
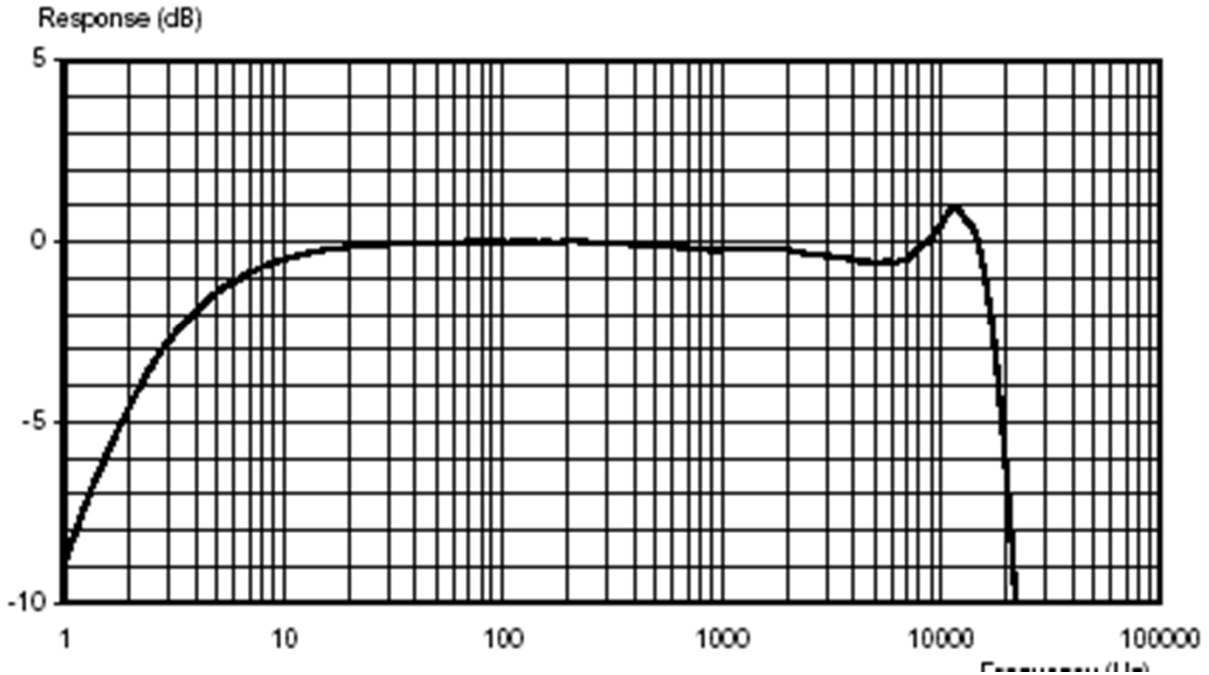


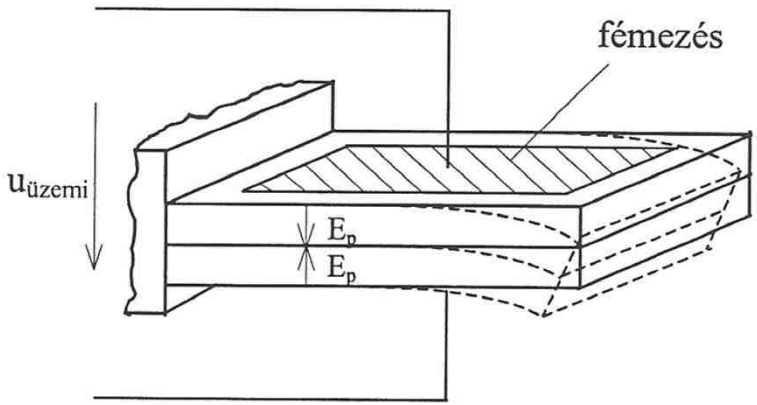
***Fig. 1** Typical pressure field response of the microphone with protection grid. The low-frequency response is valid when the vent is exposed to the sound field*

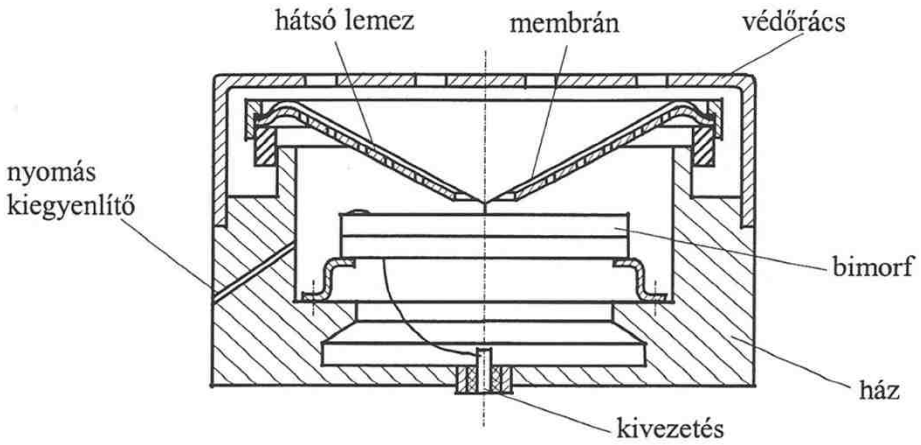


Condenser (measuring/studio) microphones



Piezoelectric microphone





Highly directional mics

shotgun microphones

dish microphone

Artificial head / torso

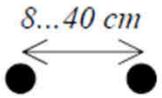
- for high fidelity, good quality stereo recordings and for measurements (NVH, automotive)

Stereo microphone techniques

A koincidens technika a tér egy pontját veszi több mikrofonnal, a mikrofonok közötti elválasztást az eltérő iránykarakterisztikák adják

Coincident method

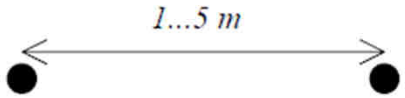
Distinction is given by differing directional characteristics of mics



A közel-koincidens technika a tér közeli pontjait veszi több mikrofonnal, a mikrofonok közötti elválasztást az iránykarakterisztikák mellett az eltérő pozíciókból adódó fáziseltérések határozzák meg.

Nearly coincident method

Distinction is given both by differing directional characteristics of mics and phase deviations



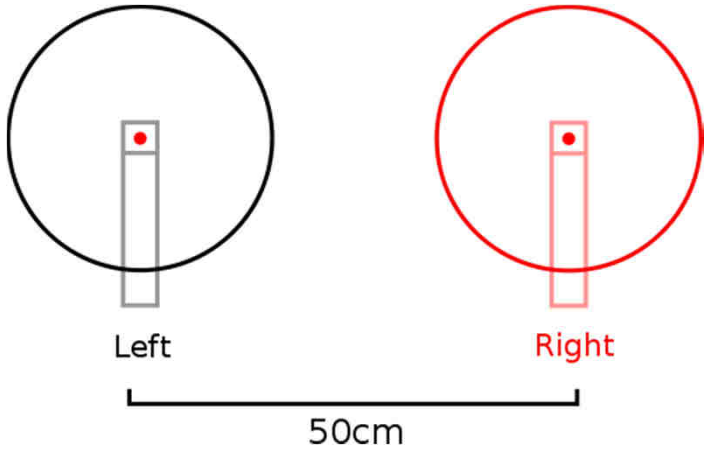
A távol helyezett vagy AB-technika a tér távolabbi pontjait veszi több mikrofonnal, a mikrofonok lényegesen különböző, szinte független jeleket vehetnek még ugyanarról a hangforrásról is.

Faraway configuration

Mics record nearly independent signals

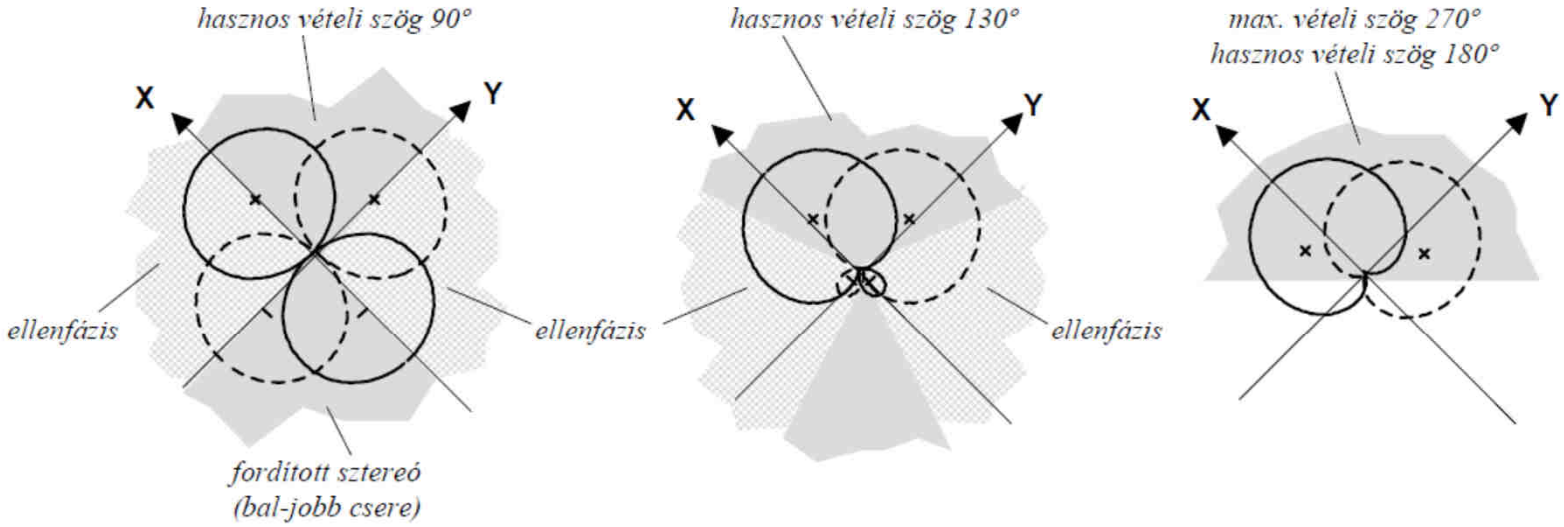
Stereo microphone techniques

- A-B microphone configuration



Stereo microphone techniques

- XY microphones (intensity stereophony)



két nyolcas, 90°:
„STEREOSONIC"

két szuperkardioid

két kardioid 135°:
„XY sztereó"

Stereo microphone techniques

- M-S (mid – side) microphone

$$L(\text{eft}) = M + S$$

$$R(\text{ight}) = M - S$$

Binaural recording – playback system

- A simple system: binaural recording by using Jecklin-disc and a headphone